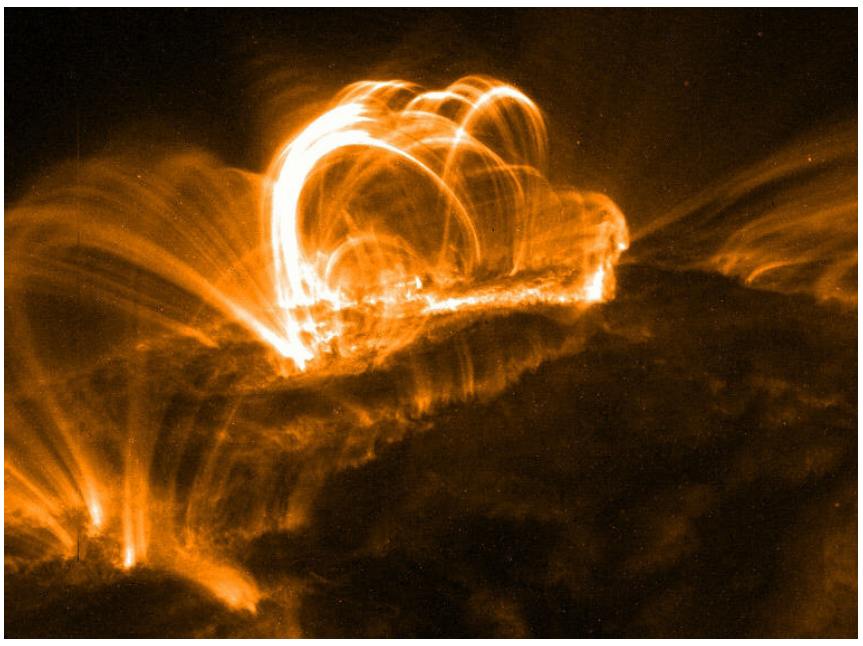
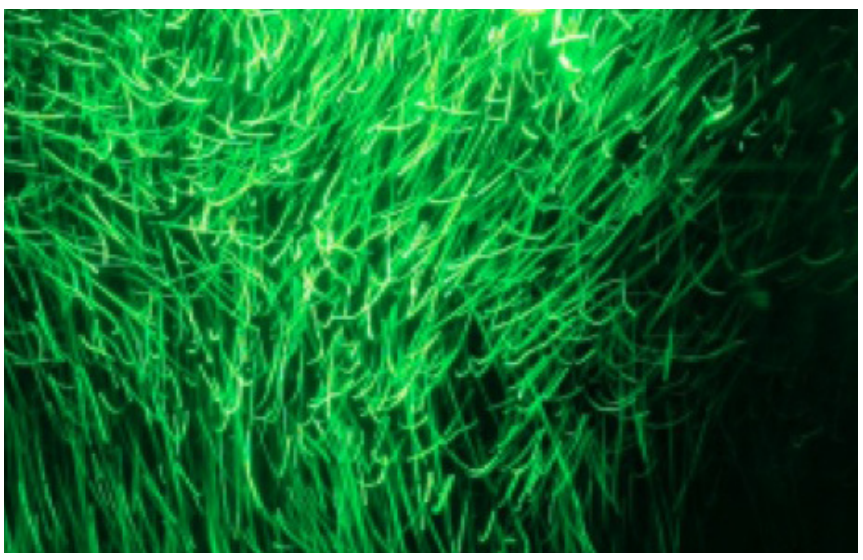
Boston University Physics Colloquium





Spontaneous Stochasticity:

"Classical Weirdness" in Turbulent Fluids

All physicists know striking examples of "weird" quantum phenomena. But even classical dynamical systems can give rise to very unexpected and strange effects that defy conventional understanding. We discuss one such example, particles advected by a rough velocity field with a Kolmogorov spectrum in fluid turbulence. This problem was studied already by Lewis Fry Richardson in a 1926 paper, which predicted his now-famous t^3-law for mean-square dispersion of particle pairs. However, it was only realized about a decade ago that Richardson's predictions imply a breakdown of Laplacian determinism for CLASSICAL dynamics! Particle motion in a fixed (nonrandom) turbulent velocity field is intrinsically stochastic and a Feynman-style sum-over-histories becomes necessary to its description. We review the current status of empirical evidence for this remarkable effect of "spontaneous stochasticity." More than just an intriguing curiosity, however, we argue that the effect plays a critical role in many turbulent phenomena in nature, in particular in magnetic dynamo and magnetic reconnection in astrophysical plasmas. We shall argue that one of the pillars of modern magnetohydrodynamics—the magnetic "flux-freezing" law of Hannes Alfvén—is fundamentally altered in a turbulent plasma.

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February 2, 2010 (Tuesday) at 3:30pm (Refreshments at 3:15pm)
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Call: Winna Somers (wsomers@bu.edu) (617) 353-9320
Host: William Klein